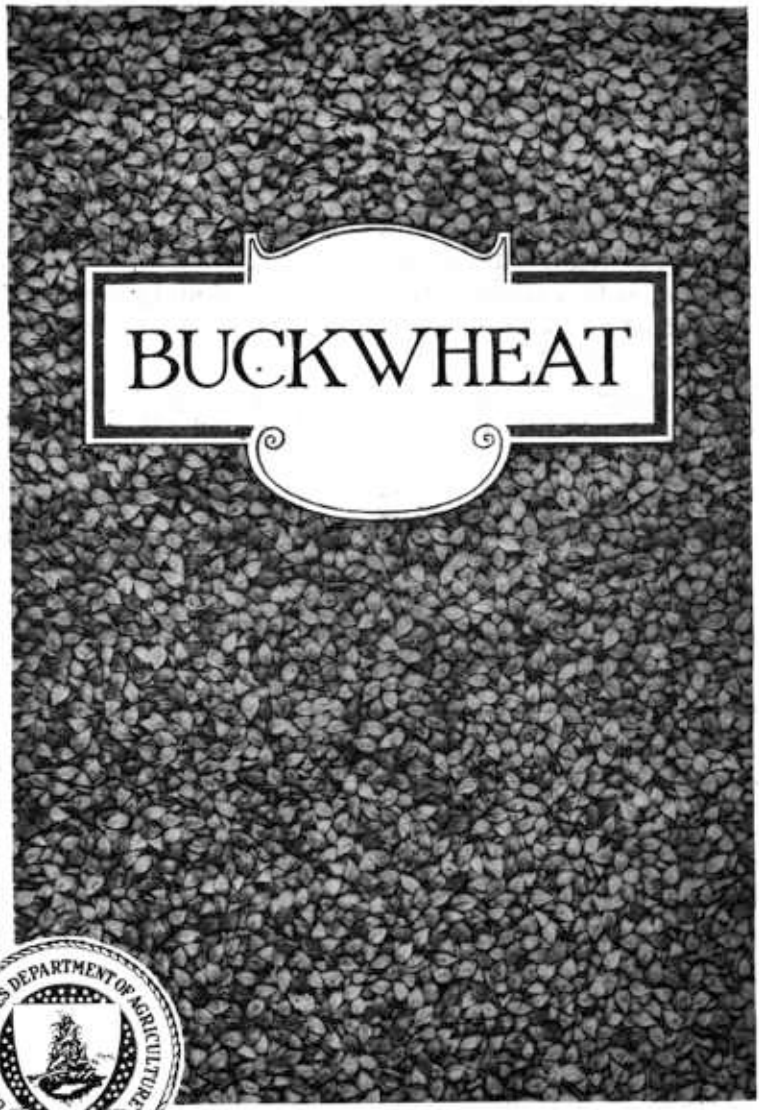
Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

Ag84F
No. 1062
rev. 1927

U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1062 Rev. 5/27

BUCKWHEAT



BUCKWHEAT is grown principally in the northeastern part of the United States, more than 60 per cent of the crop being produced in New York and Pennsylvania.

Buckwheat is in general the best grain crop for poor, thin land and succeeds well on acid soils. It is a good crop on new land and on old sod land being again brought under the plow.

It does best where the climate is cool and moist, so it is best adapted to the Northern States or to mountainous regions.

Buckwheat can make use of insoluble phosphorus and potassium to better advantage than other grain crops.

As a crop buckwheat is valuable as a weed destroyer, as a soil renovator, as a summer cover and green-manure crop, and as a source of honey for bees.

The grain is the source of food and feed, and the straw has feed and fertilizing value.

Washington, D. C. Issued October, 1919; revised May, 1927

BUCKWHEAT.

By CLYDE E. LEIGHTY, *Agronomist in Charge of Eastern Wheat Investigations, Office of Cereal Crops and Diseases, Bureau of Plant Industry.*

CONTENTS.

	Page.		Page.
The place of buckwheat in our agriculture	3	Harvesting	15
Climatic requirements	5	Thrashing and yields	16
Soils adapted to buckwheat	6	Plant diseases and insect enemies	17
Preparation of the soil	7	Uses of buckwheat	17
Rotations	7	Feeding value	18
Fertilizers	8	Buckwheat as a weed destroyer	19
Varieties	10	Buckwheat as a soil renovator	19
Seed preparation	13	Buckwheat as an orchard cover	20
Time of sowing	13	Buckwheat as a honey plant	21
Germination and growth	14	Milling	22
Method of sowing	14	Acreage, production, and value	23
Rate of sowing	15	Weight per bushel	23

THE PLACE OF BUCKWHEAT IN OUR AGRICULTURE.

THE UNITED STATES is the third largest buckwheat-producing country of the world, being surpassed by Russia (prewar European and Asiatic) with over 55,000,000 bushels (1909–1913 average) and by France with over 21,000,000 bushels (1909–1913 average). The production in the United States for the same period was 16,616,000 bushels. Canada produced about one-half and Japan about one-third as much as the United States. The average yield per acre in the United States was about 20 bushels. In Canada the yield was 3 or 4 bushels more and in Japan about the same amount less than in the United States. Russian yields were about one-half those of the United States. Our exports and imports are not large and usually about balance, although they vary considerably from year to year.

Buckwheat, however, is a comparatively unimportant crop in this country. For every bushel of buckwheat there are produced about 200 bushels of corn, 60 bushels of wheat, 100 bushels of oats, 15 bushels of barley, and 4 bushels of rye. Buckwheat, furthermore, is never likely to attain greater relative importance as a crop. But it has a

place, limited when compared to our staple crops, yet none the less important, in a large area of the country. Buckwheat cakes for breakfast will always be in demand in American homes.

Buckwheat is grown principally in the northeastern part of the United States, more than 60 per cent of the crop from 1924 to 1926 (Table III) being produced in Pennsylvania and New York, while about 20 per cent was produced in West Virginia, Ohio, Michigan, and Minnesota. The map below (fig. 1) shows where the buckwheat crop was produced in 1919. About the same acreage in the same region is now devoted to the crop.

Buckwheat is in general less critical as to soil conditions and more critical as to climatic conditions than the other grain crops. From north to south it becomes more and more a crop only for the higher

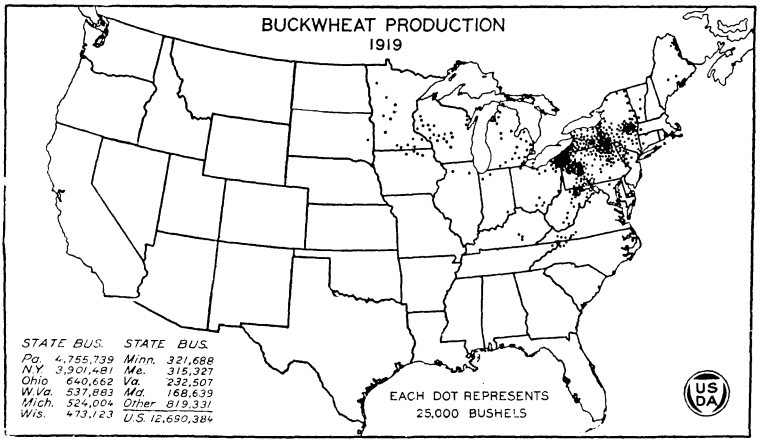


FIG. 1.—Outline map of the principal buckwheat-producing region of the United States, showing the production of this crop in 1919, as determined by the census of 1920. Each dot represents 25,000 bushels.

elevations, for it requires cool and moist weather, especially at blooming time.

Buckwheat is in general the best grain crop for poor, thin land. Its natural and favorite environment is "back in the hills." On land where wheat or even rye can not be grown with profit buckwheat is often able to produce a profitable yield. The climatic conditions, however, must be favorable.

On acid soils, which are quite common in the Northeastern States, buckwheat does well. It does not require large supplies of lime in the soil, although lime is taken up largely by the plant.

Low-grade fertilizers may be used to advantage in the growing of buckwheat, as it can make use of relatively insoluble materials to

better advantage than the other grain crops. It may be used to render available insoluble phosphates, like rock phosphate, as these are taken up by the plant in larger quantities than by other small grains. To obtain the greatest benefit from such applications to following crops, the buckwheat should be grown as a summer cover crop to be plowed under as green manure in preparation for fall seeding.

Buckwheat serves to make even very hard land mellow and friable. Consequently it is a good crop to use in preparation for such crops as potatoes.

As it has a short growing period, buckwheat can be grown on land where spring-sown crops, such as corn, have failed to make a stand. It can also be used where the land can not be worked until late, or where other crops have been drowned out by late spring floods.

Buckwheat can be used to enlarge farm activities. After other crops that must be sown early are all in there is often time to prepare land and sow buckwheat. On account of the short growing season it may be sown later than any other grain crop. Where it is so used it often may be advisable to sow it even on rich land which otherwise could be used more profitably for other crops.

Buckwheat is a suitable crop for growing on new ground. Land just cleared of timber or drained marsh land containing much decaying vegetable matter will produce good yields of this grain.

CLIMATIC REQUIREMENTS.

Buckwheat does best where the climate is moist and cool. It is very sensitive to cold, being quickly killed when the temperature falls to freezing or at most to 3 or 4 degrees below. Nevertheless, it is grown far north and at high altitudes. This is due to its short growing season, only 10 to 12 weeks, and to the small amount of heat required for the total development of the crop. At blooming time it is sensitive to high temperatures and to dry weather, especially when both day and night are hot or when accompanied by hot, drying winds. Hot weather with constant rain also is unfavorable. Under such conditions many or all of the flowers then in bloom may be blasted and produce no grain. Rather high temperatures during the day apparently are not so destructive if the nights are cool, the winds not excessive, and the soil not too dry. Unfavorable weather in the principal flowering period tends materially to reduce the yield of grain. A few days of unfavorable weather at this time may seriously reduce the yield or even destroy the crop altogether. Largely for this reason, buckwheat is often an uncertain crop, especially in regions where these unfavorable weather conditions are likely to oc-

cur. To avoid them as much as possible, sowing is delayed as long as it is safe to do so, thus allowing the principal growth in warm weather and the formation of seed in the cooler weather of late summer.

Buckwheat can be grown with at least fair success almost anywhere north of the Cotton Belt, and it is grown to some extent even there. It is best adapted to New York, Pennsylvania, Ohio, Michigan, Wisconsin, New England, and to the mountainous sections of Maryland, West Virginia, Virginia, Kentucky, North Carolina, and Tennessee. In the northernmost States it can be sown generally without reference to elevation, but farther south it is best adapted to the uplands and mountainous sections, although good crops often may be obtained on the lower lands when climatic conditions are favorable.

SOILS ADAPTED TO BUCKWHEAT.

Buckwheat will produce a better crop on infertile, poorly tilled lands than any other grain if the climatic and other conditions are favorable. It responds to good treatment, however, with increased yields. It is well suited to light well-drained soils, such as sandy loams, and to the silt-loam soils. It is not a good crop for heavy wet soils. It needs but little lime, growing well where alfalfa and red clover would not succeed; in fact, it seems to prefer an acid soil. Soils in which limestone is abundant are not well suited to buckwheat. It is often sown on newly cleared land, on drained marsh land, or on other land where the decaying leaf mold or other vegetable matter render conditions unsuitable for most other grain crops.

When the soil is poor it is profitable to use fertilizer, but where fairly good wheat or corn crops can be produced without fertilizer it is unnecessary for the buckwheat crop. On rich soils, especially those high in nitrogen, the crop usually lodges badly. Buckwheat is in reality a crop for poor lands, for there it can compete successfully with other grain crops, while for rich land there are usually more profitable crops. As pointed out elsewhere, however, it may sometimes be good farm practice to grow buckwheat on rich land.

Although the growing period is short, root development is vigorous and extensive, the roots themselves, however, being as a whole of rather delicate structure. The roots are of such a nature that they can utilize relatively unavailable mineral foodstuffs in the soil. In this respect buckwheat has a distinct advantage over the other grain crops, being better able to extract needed mineral elements from the soil particles and from added fertilizer.

PREPARATION OF THE SOIL.

Buckwheat is too often sown on land carelessly and hastily prepared. Frequently it will produce fair crops under such conditions, but better returns can be expected when more care is taken in preparing the seed bed.

The best results can be obtained by plowing the land early in the spring and keeping it in condition by occasional harrowing until the crop is sown. A reserve of moisture is thus provided, which will go far toward producing the crop. Good yields are often obtained, however, on land plowed and harrowed just before sowing. If plowing is done late the land should be well worked to settle and make firm the seed bed. The preparation of the seed bed for buckwheat should be in general the same as that for corn. Where it is adapted, buckwheat is an excellent crop to sow where corn or some other crop has been planted but where a stand has not been secured, or where the crop has for some reason been lost. Such land can be prepared for buckwheat by disking or harrowing. Old meadow and pasture lands are usually very suitable for buckwheat. Fields where the yields of hay and grass promise to be small can often be profitably sown to buckwheat. Such land, if possible, should be plowed deeply several weeks before sowing time. Meantime it should be worked occasionally with disk or harrow to keep down weeds, preserve moisture, and fit the seed bed.

Many buckwheat growers fit the land in June, shortly before sowing the crop and just after the silage corn or other late crops are planted. By distributing labor this allows a larger acreage to be cropped.

ROTATIONS.

Buckwheat is not usually included in a definite rotation, although it frequently precedes potatoes. It very often produces paying crops on land too poor to raise good crops of corn or wheat. When grown on such land, a rotation is hardly possible or advisable. Buckwheat is often grown year after year on the same land with little or no apparent ill effect, but it will exhaust the soil sooner or later if not properly fertilized. Rye is better suited to the poorer soils on which buckwheat is largely grown than any of the other cereals. Because of this fact, it should often have a place in rotations with buckwheat.

A good rotation for much of the area suited to this crop is: First year, alsike or crimson clover; second year, buckwheat; third year, potatoes; fourth year, rye, oats, or wheat seeded to clover.

The following rotations designed for building up the land have been advised for use in the mountainous region of North Carolina, and are doubtless applicable in other buckwheat sections are well:

No. 1.—First year: Corn, crimson clover seeded in corn at last cultivation.
Second year: Buckwheat, rye after buckwheat.
Third year: Soy beans, wheat.
Fourth year: Wheat, red clover.
Fifth year: Red clover.

Buckwheat is sometimes used as a nurse crop for clover, and where this is the case the rotation may be modified to meet the need.

No. 2.—First year: Corn.
Second year: Rye, clover (red or sweet).
Third year: Clover.
Fourth year: Buckwheat.
Fifth year: Clover (crimson).

Before seeding either of the clovers mentioned above on soils which are acid or sour, a liberal application of limestone, shells, or marl should be given the land. For the best success with sweet clover not less than 3 tons per acre of these materials should be applied some time in advance of the seeding, but 2 tons per acre may be sufficient for the crimson or red clover. Where heavy applications are made, a second may not be needed for four or five years, but where only 2 tons per acre are used, a second treatment of about the same amount should be given in three or four years.[1]

FERTILIZERS.

MATERIALS REMOVED IN THE CROP.[2]

A yield of 1,000 pounds of buckwheat grain removes from the soil 17.3 pounds of nitrogen, 10 pounds of phosphoric acid, and 7 pounds of potash. The same quantity of dry straw removes 8.3 pounds of nitrogen, 1.3 pounds of phosphoric acid, and 11.3 pounds of potash. The estimated average yield of buckwheat in the United States is nearly 1,000 pounds per acre (19.5 bushels for 1908–1917). The yield of straw is variable and a reliable estimate is not at hand, but supposing that it averages 2,000 pounds per acre this yield of straw and 1,000 pounds of grain would remove from each acre of land 33.9 pounds of nitrogen, 12.6 pounds of phosphoric acid, 29.6 pounds of potash, and perhaps 30 pounds of lime (CaO). This is about one-fourth more nitrogen and phosphoric acid and three-fifths more potash than is removed by the average wheat crop of the country, if estimated at 15 bushels of grain and 0.9 ton of straw. Buckwheat differs from rye, wheat, and oats principally in having (1) more nitrogen in its straw, (2) more phosphoric acid in its grain than any of these, but less in its straw than oats or rye, and (3) more potash in both straw and grain with the exception of oat straw.

---

[1] Logan, G. C. Buckwheat production in North Carolina. N. C. State Col. Agr., Agr. Ext. Serv., Ext. Circ. 75, 12 p., 5 fig. 1918.

[2] Analyses mainly from Henry and Morrison. (Henry, W. A., and Morrison, F. B. Feeds and Feeding . . . ed. 15, 691 p. Madison, Wis. 1915.)

FERTILIZERS NEEDED.

When the soil is poor it is often profitable to use fertilizers for the buckwheat crop. Phosphorus is likely to be needed most in the buckwheat-growing regions and to give the best results. On very poor soil that has not been well farmed, 100 to 300 pounds per acre of a complete fertilizer furnishing some nitrogen and potash, but principally phosphorus, is probably best. A little lime is also a benefit, but it is not necessary to add enough lime to neutralize the soil acidity in order to secure good crops of buckwheat. Although the point has not been determined definitely, it seems probable that the application of lime for the crop need not exceed 500 pounds to the acre even on soils most deficient in lime.

A little nitrogen in the soil is indispensable, and on poor land its application will increase the harvest. Nitrogen in excess results in the development of straw to the detriment of grain. Lodging is likely to follow such excessive development, making harvesting difficult or impossible. Large applications of manure may be harmful in this way.

Phosphorus is useful in the production of grain, of which it increases the weight. As the soils on which buckweat is grown are usually deficient in this element, its application is especially necessary.

Buckwheat uses much potash, its straw and grain being especially rich in this element. If the land has not been well farmed, thus rendering potash available, it may be necessary to add a small amount to secure the best yields.

For soils of fair to good fertility, phosphorus is the only commercial fertilizer usually necessary for the buckwheat crop. Sufficient phosphorus for a maximum crop is contained in 150 to 200 pounds per acre of high-grade acid phosphate. It is not necessary, however, to use the soluble phosphates for buckwheat; in fact, it may be economy not to do so, for the buckwheat plant is able to take up from the soil and use much more of the undissolved mineral phosphates than other grain crops do. Experiments at the New Jersey Agricultural Experiment Station indicate that buckwheat will utilize the insoluble phosphates of rock phosphate almost as readily as the soluble phosphates of acid phosphate. Rock phosphate and other insoluble phosphates may then be used to advantage on this crop. The buckwheat crop may indeed serve as an excellent means of rendering these undissolved phosphates available.

Nitrogen and potassium are each used in comparatively large amounts by this crop. It has been determined at the New Jersey station that buckwheat (also soy beans) will readily use the insoluble potash present in the greensand marls. It is entirely probable that

in practically all soils buckwheat can secure sufficient potash for its requirements. Other crops grown in rotation should make nitrogen available in sufficient quantity and at a cost lower than that at which it otherwise could be applied. The nitrogen used should be that taken from the air and stored in the soil by the clovers or other crops, like cowpeas and beans.

VARIETIES.

Three varieties of buckwheat commonly are grown in the United States—the Japanese, the Silverhull, and the Common Gray. These belong to the species *Fagopyrum esculentum.* Kernels of the Japanese and the Silverhull are shown in figure 2. The Japanese variety is perhaps most widely adapted, although under certain conditions the other varieties are better. The seeds of the Japanese variety are largest and are brown to dark brown in color, while the others are lighter. The Silverhull seed is smallest and is glossy or silvery in appearance. The larger seeds of the Japanese variety are harder to dry and unless well bolted in milling make a somewhat darker flour than the Silverhull. These common varieties are about equally regarded for milling purposes, although one or the other may be favored locally.

The varieties as generally grown are not pure; in fact, many growers consider it best to mix half-and-half seed of the Silverhull and Japanese varieties for sowing. The plants have somewhat different habits of growth, the Japanese generally growing taller and branching less than the Silverhull, and so the two when grown together may occupy the land to better advantage. It is also possible that on account of slightly different blooming periods or for some other reason one or the other may escape injury by unfavorable weather conditions. Being thus grown together, the different varieties often have crossed among themselves, resulting in considerable mixtures of the varieties themselves and of their hybrids.

Several varieties of buckwheat have been introduced into the United States from foreign countries in recent years. Russian No. 1 and Orenburg No. 6 have given good results in North Dakota. Sando Soba, an introduced variety of the Japanese type, seems to be the best variety of 12 or more tested in Kansas.[1] The Chinese buckwheats tested in Kansas were hardier and more drought resistant than were the other varieties and were generally longer in maturing. The Chinese varieties have smaller kernels of a peculiar shape and are less attractive in appearance than the Japanese variety. The comparative milling value has not been reported.

[1] Cory, V. L. Cooperative grain investigations at McPherson, Kans., 1904–1909. U. S. Dept. Agr., Bur. Plant Indus. Bul. 240, 22 p. 1912.

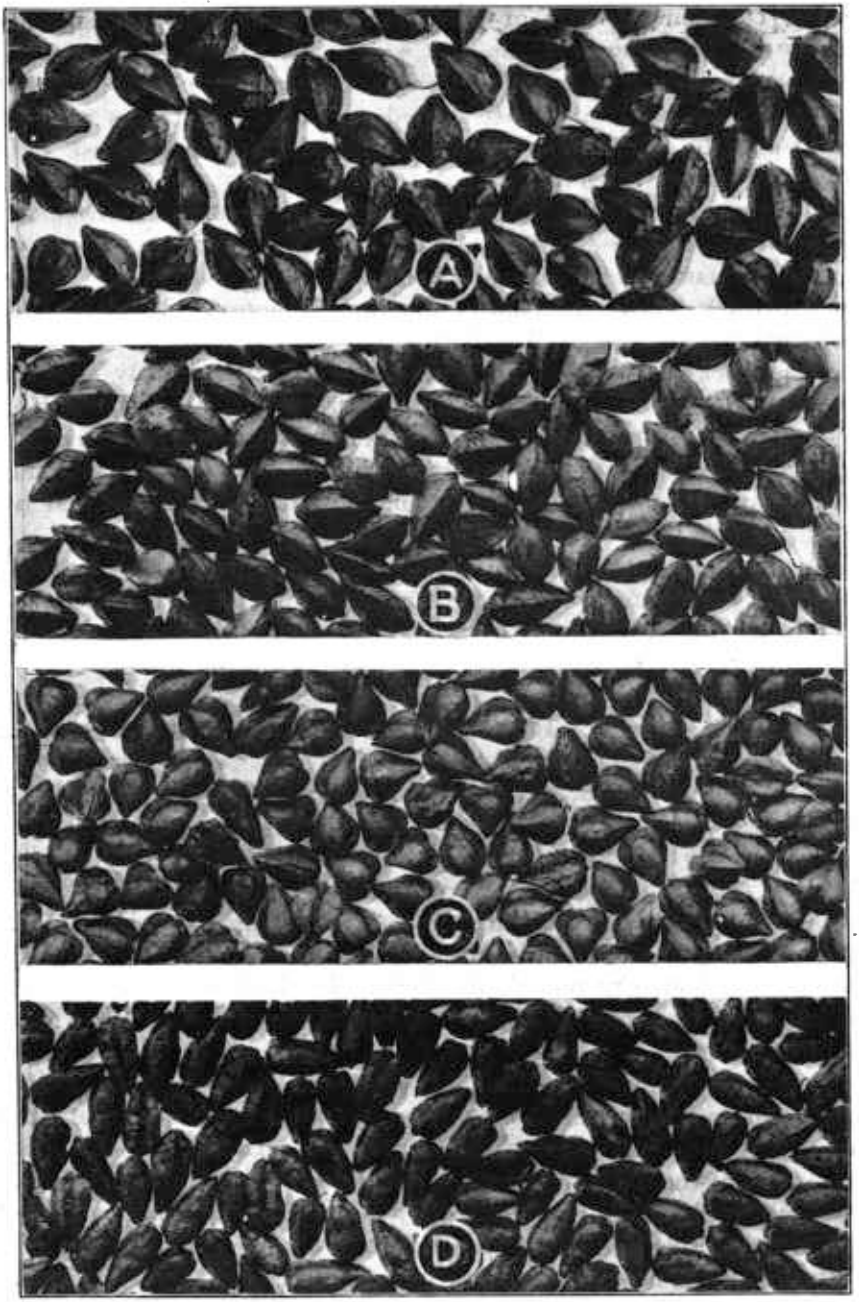


FIG. 2.—Seeds of four varieties of buckwheat: *A*, Japanese; *B*, Silverhull; *C*, Mountain; *D*, "Rye." *A* and *B* belong to the species *Fagopyrum esculentum*; *C* and *D* to the species *Fagopyrum tataricum*. (About double natural size.)

The common varieties of buckwheat have smooth and shining seeds, the three acute angles of which are usually regular and entire; the white or rose-colored flowers occur in rather large clusters, or heads; the leaves are heart shaped, as wide or nearly as wide as long; and the stems when fresh are colored green to purplish red, becoming brown when mature.

In some places the Tartary buckwheat (*Fagopyrum tataricum*), seeds of which are shown in figure 2, is grown. This species is known by many names, among which are India wheat, "Rye" buckwheat, Duck wheat, Bloomless, Marino, Mountain, Siberian, and apparently sometimes as Wild Goose and Calcutta buckwheat. The Tartary buckwheat has a dull roughened seed with slightly notched angles and furrowed surfaces, which with the smaller size easily distinguish it from the common varieties. The leaves of the plant are narrower and arrow shaped, the plant is more slender, and the flowers are greenish white, small, and are on shorter stems and in smaller heads than the common varieties.

The Tartary buckwheat is reported as being grown to a limited extent in the mountains of North Carolina, in Maine, in New York, and in several other parts of this country and Canada. It is preferred in certain places because it appears less subject to injury by frost and is better adapted to the roughest, least favorable lands than the ordinary varieties. It is also reported as being able to endure more lime in the soil than these other varieties. It is often grown on poor or on new land, and usually yields well even where the others would fail.

This Tartary buckwheat is not so good for flour making as the common varieties. The amount of flour in the grain is less and the flavor is not generally thought to be so good, being somewhat bitter. The grain is often used as feed for horses and hogs after it has been ground and bolted to remove the hulls. To chickens it may be fed without grinding, but the sharp hull causes trouble when fed whole to other animals.

The notch-seeded buckwheat (*Fagopyrum emarginatum*) is not known to be grown pure in this country, although seeds of it can sometimes be found mixed with the common varieties. In this sort the angles of the hulls are extended and form wide margins or wings. It should probably be considered only as a variety of common buckwheat and not as a different species.

Buckwheat is not really a cereal, as are corn, wheat, rye, and oats, but the grain has similar uses and so it is usually considered with the cereals.

SEED PREPARATION.

Large heavy seeds of buckwheat will produce larger plants and more grain than small seeds. Cleaning and grading the seed should result then in more vigorous plants and more even stands with better yields. The removal of foreign material, such as sticks and straw, from the seed will allow more uniform seeding. Buckwheat retains its vitality for several years, but it is best to use seed not more than 1 year old. Two-year-old and even older seed may be used, the rate of sowing being increased to make up for decreased germination. Old seed should be tested for germination before it is used for sowing, as should also any seed of doubtful vitality.

Tests made in France of seeds of four kinds of buckwheat kept under good conditions showed the following average germination for the seed of different ages:

	Per cent.		Per cent.
Year grown	98.5	3-year-old seed	68.0
1-year-old seed	97.0	6-year-old seed	28.5
2-year-old seed	86.5	8-year-old seed	1.0

These results show that buckwheat seed gradually loses its germinative power.

TIME OF SOWING.

The time of sowing buckwheat is well along in the season after all danger of frost is past. The plant is very sensitive to cold and is killed by the first heavy frost. It fills best in cool weather, however, and so the sowings are deferred to allow only time for the crop to mature before frost occurs. Sowing is general in New York, Pennsylvania, and Michigan from June 24 to July 1. Sowing may take place either a week before or a week after these dates, the earlier dates being safer for the more northern points in Michigan, Wisconsin, and New York. When seeded at this time it is most likely to escape injury from hot weather, which, with drying winds and hot nights, causes the flowers to blast and fail to produce seed. July sowing is likely to be too late in the more northern sections and at higher elevations or on land where frost pockets occur. It is seldom advisable in any district suited to buckwheat growing to sow later than July 15. The seeding time for any locality is determined fairly accurately by allowing it a period of 12 weeks for growth before the first killing frost is expected. Under the most favorable conditions a buckwheat crop will mature in 10 weeks, but the average time is about 12 weeks. Harvesting is general in New York, Pennsylvania, and Michigan about September 16 to 18.

GERMINATION AND GROWTH.

Buckwheat germinates best when the soil temperature is about 80° F. It will germinate, however, when that temperature is anywhere between about 45° and 105° F. In order to germinate, the seeds must absorb about one-half their weight of water.

Under average conditions the first shoots of the buckwheat plants appear at the surface of the soil in about a week after sowing, and the first leaf is formed in about 3 weeks. Blooming begins 5 or 6 weeks after sowing, and the first grains are ripe in about 10 weeks. Complete maturity may be reached from 2 to 5 weeks later.

Two crops of buckwheat annually on the same land have been raised in West Virginia. This practice, while it can not be recommended as desirable, is possible wherever the growing season is sufficiently long. In such cases the first crop must be sown as early as practicable in the spring, and the second sowing must follow immediately after the removal of the first crop.

FIG. 3.—Four seed drills at work in a large buckwheat field in New York State. Less seed is required than for broadcast sowing.

METHOD OF SOWING.

Buckwheat may be sown with a grain drill or broadcasted and harrowed in. Where the nature of the ground allows, the drill should be used, as less seed is required and better results may be expected. Broadcasting the seed is a rather common method with this crop. It should be sown to a depth of one-fifth inch to 2 inches, depending on the nature of the seed bed. Drilling buckwheat on a large farm in New York is shown in figure 3.

RATE OF SOWING.

Buckwheat generally should be seeded at the rate of 3 or 4 pecks per acre. As much as 5 pecks is sometimes sown. If the soil is fertile and free from weeds and the seed is of good vitality, as little as 2 pecks may be sufficient when sown with a drill. It is often the practice, however, to make heavier sowings on rich land, as it is thought that the denser growth somewhat prevents lodging. The Tartary buckwheat grown in some parts of the United States does not require more than 2 pecks of seed to the acre, as the kernels are smaller.

On fertile land buckwheat branches freely and occupies considerable space. On poor land or when sown thickly few branches are

FIG. 4.—Buckwheat in shocks made by setting up unbound bunches and tying the top with a strand of the plants.

formed and less development of the individual plant takes place. In this way, although it does not tiller like wheat, rye, oats, and barley, buckwheat adapts itself to its surroundings perhaps as effectively as these crops.

HARVESTING.

Expensive machinery is not absolutely needed for harvesting the buckwheat crop. A cradle or scythe must often be used, on account of the rough land on which the crop is grown. The drop or self-rake reaper is one of the most satisfactory machines for harvesting. This machine drops the cut plants in loose bunches, which later can be gathered and set up in the ordinary loose shock. These shocks are formed by setting up together several bunches from the cradle or

drop reaper and tying them near the top with some strands of the straw. Such shocks are shown in figure 4. They have much the appearance of corn shocks reduced in size.

Many farmers use the ordinary binder, which practice is advisable where the land is not too rough and the plants are not too short. Under ordinary conditions the plants attain a height of about 3 feet and under very good conditions about 5 feet. They can then be harvested with a binder. Losses when the binder is used are apparently no larger than when other means of harvesting are employed. The bundles from the binder should be set up soon after cutting, from two to four being placed together. If allowed to wilt before being shocked, the bundles do not stand up so well.

Buckwheat is usually harvested when the seeds from the first lot of blossoms are fully mature. If frost threatens, cutting may be begun as soon as the seeds from the first lot of blossoms have fully formed. When cut at this stage, the seed will mature in a few days if too rapid drying out is avoided. The stems contain considerable juice, and if left in large enough bunches on the ground or in shocks will dry out slowly. If the crop is left standing until the first lot of seed is fully mature, considerable loss from shattering will occur, which is likely to reduce the yield below what it would be if cut earlier. Losses from shattering are avoided by doing the cutting in the morning when the dew is on or in damp weather. The cut buckwheat is usually left in the field in the shocks until thrashing time, when it is drawn in. It requires usually from a week to 10 days of good weather to dry out in the field before being in condition to thrash. It may be stacked or stored in a mow if it is first allowed to dry out thoroughly or if it is to be stacked or stored for only a few days before thrashing.

THRASHING AND YIELDS.

Buckwheat is thrashed either with a flail or by machinery. If a flail is used the straw should be dry and the weather good, as then the grain shells out easily. With a thrashing machine the straw need not be so dry. The machine is modified by the removal of the spiked concave, a smooth concave or one with only a few teeth being left in or a fitted plank being substituted. This is done to prevent cracking the grain and breaking up the straw more than is necessary. The grain is more easily thrashed than that of the cereals.

Buckwheat thrashes easily because the pedicels or short stems which bear the kernels are slender, and these and the straw are very brittle when dry, resulting in easy shattering.

Yields of buckwheat are variable, being usually between 15 and 30 bushels per acre; but the yield may be as high as 50 bushels under

very favorable conditions, while very low yields are frequent. The average annual yield in the United States has varied from 16.5 to 20.9 bushels per acre in the last 10 years, the average for that period being about 19 bushels.

PLANT DISEASES AND INSECT ENEMIES.

Buckwheat is particularly free from destructive plant diseases or insect enemies, and losses do not often occur from these causes. Birds and poultry when abundant may eat a considerable quantity of the grain before it can be harvested. The blasting of the flowers often occurs as a result of unfavorable climatic conditions, but this is not due to disease. The flowers appear to be very sensitive to high temperatures and dry weather and often fail to develop grain because of such weather. The Japanese variety seems to be less injured by such conditions than the common or Silverhull varieties.

USES OF BUCKWHEAT.

Buckwheat flour is used extensively in the United States for making griddle cakes. A batter made of the flour and usually including yeast or some other leavening agent is spread thinly on a smooth, hot, greased iron griddle or soapstone plate, where baking is completed within a few minutes, the cakes being turned in the process and browned on both sides. They are eaten hot, usually with sirup. The cakes are generally rather dark in color, owing to the presence in the flour of portions of the hull of the grain. A kind of groats also is made for human food by removing the hull and breaking up the inner portion of the grain.

Buckwheat analyses are quoted and comparisons with other cereals made in Farmers' Bulletin 249, entitled "Cereal Breakfast Foods." Considerable attention has been given to buckwheat cookery in the Department of Agriculture, especially in studies of wheat substitutes and their uses. Experiments have been made on the thoroughness of digestion of buckwheat. Those interested in these subjects and also in the food values of buckwheat as compared with other grains can obtain such information, on request, from the Bureau of Home Economics, United States Department of Agriculture.

When buckwheat is eaten constantly or fed in too large quantities it sometimes causes a rash to appear on the skin. This seems to be confined to white-colored animals and apparently has some connection with the light relation of the animal, as this rash does not occur if the animals are not exposed to light. The substance that produces these effects is apparently located in the hulls, particles of which usually remain in the flour.

The outer hulls of buckwheat removed in milling are used for fuel, as packing material for bottled goods and bulbs, and to some extent for mixing into stock feeds. They contain considerable carbohydrate and other nutrient material and are consequently of some small value as feed.

The buckwheat middlings obtained in milling are composed of that portion of the grain just beneath the hull, the inner covering of the grain together with the germ of the kernel. They contain large amounts of protein, carbohydrate, fat, and mineral matter. These middlings are a very valuable feed for cattle, producing a large flow of milk, and are used principally by dairymen. They apparently have no bad effects on the animals or the dairy products if not fed in excess or as the only concentrate. The manure from stock fed with middlings has a high fertilizing value because of the nitrogen, phosphorus, and potassium contained in it.

Buckwheat bran and buckwheat feed are mixtures of the middlings and the hulls. They vary in composition, but are usually much poorer as a feed than the middlings alone.

The whole buckwheat grain is a good poultry feed. The straw is sometimes used for feed and is more readily eaten by stock if well preserved. It contains a large amount of nutrient material, being rich in minerals and carbohydrate. It makes good bedding for cattle, but does not last well. Since it contains a large amount of mineral matter and rots quickly it makes a good manure. It is frequently plowed under as green manure in preparation for wheat or other fall seeding. When used in this way it leaves the ground mellow and doubtless renders considerable plant food available.

FEEDING VALUE.

The composition of buckwheat and several of its products is shown in Table I. Buckwheat grain contains in each 100 pounds 10.8 pounds of crude protein, 72.5 pounds of carbohydrates, and 2.5 pounds of fat. The same quantity of straw contains 5.2 pounds of crude protein, 78.1 pounds of carbohydrates, and 1.3 pounds of fat. Buckwheat grain contains a little less crude protein than wheat, rye, and oats, and about the same as corn. It has more fat than wheat and rye, and about one-half as much as oats and corn. It contains about three-fourths as much digestible carbohydrates as wheat, rye, and corn, and about the same as oats. The buckwheat straw contains about two-thirds more crude protein than the straw of wheat, rye, and oats, and about the same as corn stover. It contains about as much fat as corn stover or wheat or rye straw, and half as much as oat straw. In digestible fat, buckwheat straw is superior to any of these other straws, containing from about one-third more to three times as much.

It contains less digestible carbohydrates than corn stover or the straw of these other grains.

TABLE I.—*Composition of buckwheat and its products, giving the parts in 100 pounds.*[1]

Buckwheat and products.	Water.	Ash.	Crude protein.		Carbohydrates.			Fat.		Nitrogen.	Phosphoric acid.	Potash.
			Total.	Digestible.	Fiber.	Nitrogen-free extract.	Digestible.	Total.	Digestible.			
Grain	12.1	2.1	10.8	8.1	10.3	62.2	49.7	2.5	2.5	1.73	1.00	0.70
Flour	12.8	1.1	7.9	5.9	.6	76.1	58.0	1.5	1.5	1.26	.44	.19
Middlings	12.0	4.8	28.3	24.6	4.8	42.7	38.3	7.4	6.1	4.53	2.34	1.18
Hulls	10.3	2.1	4.4	.4	43.7	38.5	13.9	1.0	.7	.70	.57	.86
Straw	9.9	5.5	5.2	4.2	43.0	35.1	26.3	1.3	1.2	.83	.13	1.13
Green fodder[2]	63.4	3.6	4.6	2.2	8.0	19.5	17.4	.9	.5	.74	.20	.93

[1] Henry, W. A., and Morrison, F. B. Feeds and Feeding ... ed. 15, 691 p. Madison, Wis., 1915.
[2] Japanese buckwheat.

BUCKWHEAT AS A WEED DESTROYER.

Buckwheat germinates quickly after being sown and makes a rapid growth that quickly and, where the soil is not too poor, completely shades the ground. This heavy growth will smother many weeds.

Buckwheat is useful in fighting quack-grass, a pest on so many farms in the Northeastern States. Some farmers report entire eradication of quack-grass in a single season with the help of buckwheat, but usually such complete results are not to be expected. The land that is to be cleared of quack-grass should be cropped a year to get rid of sod. It should then be plowed in the fall or early spring. All quack-grass plants must be kept down until buckwheat-sowing time by sufficient workings with the spring-tooth or disk harrows, or by plowing again if necessary. If the land is poor some manure and fertilizer should be added. At the proper time 4 or 5 pecks of buckwheat should be sown to the acre. If the land is rich enough to produce a good growth of buckwheat it should smother out most, if not all, of the quack-grass, and a good crop of grain will also be harvested. Thus buckwheat pays in two ways—saving the labor of working the land all summer to keep down the quack-grass and returning a crop of grain.

BUCKWHEAT AS A SOIL RENOVATOR.

As a soil renovator buckwheat has great value. As just stated, it is useful in clearing the land of weeds. Experiments indicate that it can utilize relatively insoluble mineral soil constituents to better advantage than can the true cereals, such as wheat and oats, and it is well known that it will flourish on poor soil. As a green-manure crop on poor land it has value in rendering plant food available and

furnishing humus to the soil. A heavy growth plowed under, as shown in figure 5, will decay quickly and completely, leaving the residues soon available for the succeeding crop. A crop of buckwheat also leaves even hard soils in loose, friable condition, supposed to be due partly to its complete shading of the ground. Potato land is benefited by this crop.

Very poor land can be built up by following the plan of sowing rye with the buckwheat. The two grains are sown at the regular time for sowing the buckwheat, the rate of sowing being rather scant for buckwheat and about normal for rye. The rye is covered and held in check by the more rapidly growing buckwheat until this crop is harvested, after which it develops and occupies the land over winter. In the spring it is plowed under as green manure. This process can be repeated year after year, until the land is improved sufficiently

FIG. 5.—Plowing under buckwheat for green manure. It renders plant food available, decays quickly, furnishing humus, and helps to loosen hard soils.

to grow other crops. An application of lime will generally be necessary for the clovers, which should be grown for the nitrogen supplied by them.

The rye can, of course, be sown in the fall after the buckwheat crop is removed. In many cases this may be more satisfactory. The rye may often be drilled in the stubble, but disking or even plowing the land may sometimes be necessary.

BUCKWHEAT AS AN ORCHARD COVER.

Buckwheat sown alone at the usual rate per acre is frequently used as a green-manure or summer cover crop in orchards. The advantages of having a legume in the cover crop are gained by adding Canada peas. Buckwheat and Canada peas mixed have been found

in New York to be very satisfactory for this purpose. Perhaps the only objection to this combination is that the very rank growth, averaging about 2½ feet in the latter part of September, interferes rather seriously with the gathering of the fruit, especially on wet days. This may be obviated by rolling down the buckwheat before beginning the apple harvest, thus furnishing a straw carpet upon which apples may fall without injury.

BUCKWHEAT AS A HONEY PLANT.

The flowers of buckwheat furnish an excellent source of honey for bees. Several things combine to make it one of the best honey

FIG. 6.—A buckwheat field in blossom, showing the mass of flowers at blooming time, which make the plant an excellent honey producer.

plants. Many flowers are produced on each plant and one plant may produce flowers for a month or more. A field of buckwheat at blooming time presents a mass of flowers, as shown in figure 6. The flowers are usually well supplied with nectar, each one having eight nectaries. It is estimated that an acre of buckwheat growing under good conditions may supply as much as 150 pounds of honey in a season.

It is not advisable to grow buckwheat for use by bees alone. Commercial beekeeping in buckwheat-growing sections is advisable, as bees can make use of the flowers produced and may in turn be of use in fertilizing the flowers. Many buckwheat growers, in fact, believe that the weight per bushel of the seed is heavier where the

crop has been worked largely by bees. The great need in such localities, however, is for a honey plant coming on earlier in the year than buckwheat, as otherwise European foul brood is sometimes very destructive. Alsike clover, sweet clover, winter vetch, and in the more southern regions crimson clover offer possibilities in this direction.

Buckwheat honey is rather dark in color and has a distinctive flavor. It is usually highly regarded in sections where it is produced. It should generally be sold and used locally, for the public in general does not care for it so much as for white clover or other light-colored honey.

MILLING.

Various methods are employed in the milling of buckwheat. A few mills still use the old-fashioned burrs, but the greater number use rolls. The milling process is often about as follows: The grain, after passing through a separator, where all foreign material (such as sticks and stones) is removed by means of a series of sieves and all dust is blown out by an air current, is conveyed to the buckwheat shucker or break rolls, where the hulls, or outer coatings, are loosened from the inner portion of the kernel. Passing then to a machine known as the sieve scalper, these loosened hulls are removed, after which the stock is further reduced by means of one, two, or more sets of rolls. Each grinding operation is followed by a sifting of the resultant stock for the purpose of separating the finer particles from the coarser stock, the process being somewhat the same as that used in milling wheat. In the sifting that takes place the flour is finally separated almost completely from the middlings. Flour can be made as white as that from wheat by the use of fine bolting cloth, but usually coarser cloths are used, through which small particles of the hull pass and remain in the flour. These give to the flour the characteristic dark color.

According to one report, 100 parts of clean, dry buckwheat give on milling from 55 to 60 parts of flour, 20 to 25 parts of middlings, and the remainder hulls and loss. It is estimated by the United States Department of Agriculture that on the average 7 bushels (48 pounds each) yield a barrel (196 pounds) of flour, a yield of 58⅓ per cent. Higher estimates of yield, even up to 73 per cent, are reported, but the quality of flour made will doubtless be poor when the extraction is much over 60 per cent. Buckwheat more than 1 year old is reported to make flour inferior to that made from new grain.

The flour of the Tartary buckwheat is darker in color than that from the common variety, has a somewhat bitter taste, and is not so good for baking.

ACREAGE, PRODUCTION, AND VALUE.

The acreage, production, and farm value of buckwheat in the United States from 1909 to 1926, inclusive, are shown in Table II. The largest acreage in this time, 1,027,000 acres, was sown in 1918, while the smallest, 680,000 acres, was sown in 1921. The record production for this period, 19,249,000 bushels, was realized in 1912. The production in 1926 of 12,922,000 bushels was the smallest since 1916, when 11,662,000 bushels were produced. The yield of 18.3 bushels per acre in 1926 was about a bushel less than the 18-year average. The total farm value in 1926 was the lowest since 1913, and the average value per acre the lowest since 1916.

The average area, production, and farm value of buckwheat for the three years 1924 to 1926 in the principal States growing the crop are shown in Table III.

According to an investigation made on several farms in the principal buckwheat-growing county of West Virginia,[1] it required an average of 2.91 man days and 2.98 horse days to grow, harvest, and thresh an acre of buckwheat, the average yield being 24.8 bushels per acre. On this basis, if man labor is valued at 15 cents an hour, horse labor at 10 cents an hour, and the workday is 10 hours long, the cost of producing an acre of buckwheat would be $7.34. With increased labor costs the production costs would be proportionally higher.

TABLE II.—*Area, production, and farm value of buckwheat in the United States, 1909–1926, inclusive.*

Year.	Area.	Average yield per acre.	Production.	Price per bushel received by producers Dec. 1.	Farm value, Dec. 1.	
					Total.	Average value per acre.
Annual average:	*Acres.*	*Bushels.*[1]	*Bushels.*	*Dollars.*	*Dollars.*	*Dollars.*
1909–1913	843,000	20.4	17,242,000	0.698	12,033,000	14.27
1914–1920	820,000	18.1	14,867,000	1.245	18,507,000	22.57
1921	680,000	20.9	14,207,000	.812	11,540,000	16.97
1922	764,000	19.1	14,564,000	.885	12,889,000	16.87
1923	739,000	18.9	13,965,000	.933	13,029,000	17.63
1924	745,000	17.9	13,357,000	1.026	13,708,000	18.40
1925	747,000	18.7	13,994,000	.888	12,423,000	16.63
1926[2]	707,000	18.3	12,922,000	.883	11,408,000	16.14

[1] Bushels of 48 pounds.
[2] Preliminary.

Data for 1909 to 1923, inclusive, from Yearbook of United States Department of Agriculture, 1925. Data for 1924, 1925, and 1926 from Crops and Markets, Monthly Supplement, December, 1926.

WEIGHT PER BUSHEL.

The legal weight per bushel of buckwheat is 48 pounds in the States where most of the crop is produced. This weight is also established by Federal statute. The legal weight varies in different

[1] Johnson, O. M., and Dadisman, A. J. Amount and cost of labor required for growing crops in West Virginia. W. Va. Agr. Exp. Sta. Bul. 163, 11 p., map. 1916.

States from 40 to 56 pounds, while in several States no legal weight has been established. The bushel weights established in the buckwheat-producing States are shown in Table III.

TABLE III.—*Area, production, and farm value of buckwheat in the principal States producing it—3-year average, 1924–1926; also the legal weight per bushel of the grain in each State.*

State.	Area.	Production.	Value per acre, basis Dec. 1 price.	Legal weight per bushel.
	Acres.	*Bushels.*[1]	*Dollars.*	*Pounds.*
Delaware	2,700	43,300	15.42	
Illinois	5,300	73,000	14.25	52
Indiana	18,700	269,300	13.61	50
Iowa	5,300	89,300	15.32	48
Kentucky	7,300	107,300	14.48	56
Maine	14,000	340,300	22.63	48
Maryland	7,300	152,000	21.33	48
Michigan	50,700	725,700	12.67	48
Minnesota	61,300	886,700	11.83	50
Missouri	1,000	14,000	13.00	52
Nebraska	1,000	13,300	12.97	50
New Jersey	2,700	52,000	20.41	48
New York	221,300	4,346,700	18.12	48
North Carolina	10,000	180,000	19.61	50
North Dakota	7,700	90,300	8.00	42
Ohio	26,700	467,300	16.68	50
Pennsylvania	199,700	4,052,300	19.14	48
South Dakota	10,000	135,300	11.81	52
Tennessee	3,000	54,000	21.00	50
Vermont	2,700	59,700	20.82	48
Virginia	16,000	295,300	18.95	48
West Virginia	33,700	607,700	18.68	52
Wisconsin	25,000	369,300	13.03	50
United States	733,100	13,424,100	17.66	[2] 48

[1] Bushels of 48 pounds.
[2] Federal statutes.

Data compiled from Crops and Markets, Monthly Supplement, December, 1926.

U. S. GOVERNMENT PRINTING OFFICE: 1927